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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>A61L 15/44, 15/22, 15/24, 15/26, 15/28, 15/30</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 97/32613</b> <b>(43) International Publication Date:</b> 12 September 1997 (12.09.97)
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<b>(54) Title:</b> IMPROVEMENTS IN WOUND CARE MANAGEMENT		
<b>(57) Abstract</b>		
<p>The invention relates to a bandage or wound dressing fabricated from a natural or synthetic film-forming material, such as a hydrophobic polymeric membrane, incorporating a therapeutically effective amount of a therapeutically active (e.g. anti-microbial) compound within the matrix thereof. A preferred therapeutically active compound is Triclosan, which when incorporated into the bandage or wound dressing provides continuous inherent control of the growth of a broad range of microorganisms, which promotes better wound care management and wound healing.</p>		

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## IMPROVEMENTS IN WOUND CARE MANAGEMENT

### TECHNICAL FIELD

The present invention relates to improvements in wound care management using improved anti-microbial and anti-inflammatory wound dressings.

### BACKGROUND ART

It was not until the 19th century that cotton wool and gauze were commonly used to handle wounds, and cotton gauze is still often used in hospitals today as a wound dressing. The ideal wound dressing:

- Removes excess exudate from the wound, but keeps the wound moist, preventing dehydration; wound exudate is in fact a bactericide which if left in position in moderate amounts tends to speed up the healing process
- Allows gaseous exchange
- Provides thermal insulation
- Is impermeable to micro-organisms
- Has low adherence properties
- Is free from particulate and toxic contaminants.

However, the treatment of chronic wounds, ulcers and the like is a problem area where topical application of anti-microbial agents alone are ineffective in wound healing, due to a large extent to leaching of the anti-microbial agent from the wound site and the inability to be able to maintain an effective amount of the agent in contact with the wound site.

Modern fibre technology has allowed low concentrations of biocide to be incorporated into the fibres of the bandage or dressing, and in this way to prevent broad spectrum microbial growth in the target zone, and to allow the agent to remain effective over longer periods.

In recent time I have developed a product initially for veterinary applications, but which has potential for the treatment of humans, which utilises a gauze pad in an elastic bandage which is ~~adapted to conform to the treatment site~~ on the animal, wherein the textile

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material of the gauze pad incorporates the anti-microbial compound, Triclosan, within the interstitial spaces of the polymeric fibre material from which the gauze pad is fabricated.

This bandage or dressing has shown itself to be a potentially valuable product in improved wound care management, because of an unexpected apparently synergistic property of the Triclosan in this form of application, in not only preventing broad spectrum microbial growth and reducing inflammation in the target zone, but also in encouraging wound healing. However, there is room for improvement with this type of product - and especially in the area of more efficient delivery of the therapeutic agent to the wound care site and in increased therapeutically effective concentrations.

#### DISCLOSURE OF THE INVENTION

It is an object of the present invention to provide new or improved wound care dressings or bandages comprising therapeutically effective amounts of a therapeutic agent such as Triclosan which goes at least some way towards overcoming or at least minimising the prior art problems or limitations outlined above.

It is another object of the present invention to provide an improved form of bandage or dressing which allows for more efficient delivery of a therapeutic agent to the wound care site in increased therapeutically effective concentrations.

It is a further object of this invention to provide an improved form of bandage or dressing comprising a polymeric material (natural or synthetic) with one or more therapeutically active (e.g. anti-microbial) compounds incorporated within the polymeric matrix.

It is yet another object of the present invention to provide an improved form of bandage or dressing that incorporates a therapeutically active agent, or combination of agents useful in wound care management for the promotion of wound healing.

Additional objects and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention.

These and other objects of the invention will become more apparent from the following description.

According to one aspect of the present invention there is provided a bandage or dressing for wound care management, comprising an outer fabric support, preferably an elastomeric fabric support, and an inner support layer, or inner pad, wherein the inner pad includes an outer surface or membrane, preferably fabricated from a film-forming material, and incorporating a therapeutically effective amount of one or more therapeutically active (e.g. anti-microbial) compounds in the matrix thereof. The pad may be integral with or separate from the outer fabric support.

The therapeutically active agent is held in the polymeric matrices, so that migration is inhibited, causing the controlled release of the agent.

The present invention also provides a method of making the therapeutically active bandage or dressing wherein at least one therapeutically active agent is incorporated into the device by blending the agent into the polymer resin before or during forming a film of the polymeric material.

According to another aspect of the invention, the wound dressing comprises an absorbent pad having a construction similar to that used in disposable diaper-, sanitary napkin- or incontinence clothing-construction, having a gas and/or liquid pervious body-side liner, a separate outer cover sheet (optionally liquid impervious) and an absorbent body disposed therebetween. The liner and/or the absorbent body are fabricated from materials which incorporate a therapeutically effective amount of one or more therapeutically active (e.g. anti-microbial) substances in the matrix or interstitial spaces thereof, to ensure that the therapeutically active substances(s) is/are in constant close proximity to the wound site.

According to the present invention, the term "therapeutically effective amount" means an amount of therapeutic (anti-microbial) agent and/or mixture thereof which is capable of promoting wound healing and retarding or preventing microbial colonisation and

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adherence to the surface of the polymeric materials used herein while causing minimum undesirable side effects when in contact with living tissue.

#### FURTHER DESCRIPTION AND BEST MODE OF CARRYING OUT THE INVENTION

The inner surface or pad of the bandage is preferably fabricated from a natural or synthetic membrane or film-forming material of either organic or inorganic, animal or vegetable origin, or from plastics materials. For example, from gelatins or from vegetable gums, or from hydrophilic or hydrophobic film forming plastics materials such polyvinylchlorides polyacetates or polyamides which are cast or coated as a film or membrane in the usual way.

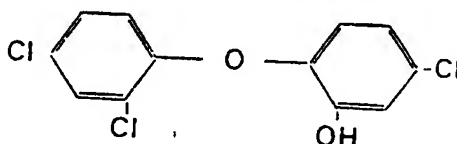
Suitable polymeric materials include but are not limited to silastic or other silicone-based material, polyethylene terephthalate (PET), dacron, knitted dacron, velour dacron, polyglacin, chromic gut, nylon, silk, bovine arterial graft, polyethylene (PE), polyurethane, polyvinyl chlorides silastic elastomer, silicone rubber, PMMA [poly-(methyl methacrylate), latex, polypropylene (PP), polyofefin, cellulose, poly vinyl] alcohol (PVA), poly (hydroxyethyl methacrylate (PHEMA), poly (glycolic acid), poly (acrylonitrile) (PAN), fluoroethylene-cohexa-fluoropropylene (FEP), teflon (PTFE), Co-Cr alloys, copolymers thereof and mixtures thereof.

According to the invention, the simplest method of incorporating the therapeutically active compounds into the polymeric material is by direct compounding of the therapeutically active substance into the plastic resin before casting or the like.

For example, the therapeutic substance(s) are ideally dissolved in a suitable solvent and incorporated into the film forming material to be cast or knife coated as a film or membrane, whereby the therapeutic substances are incorporated in the interstitial spaces of the film matrix. The film or membrane is ideally fabricated from a hydrophobic polymer which is both liquid and gas permeable, but impervious to the passage of micro-organisms. The hydrophobicity of the film or membrane is a useful feature in that it reduces the tendency for the film or membrane to become attached to the wound site.

The preferred anti-microbial substance for inclusion in the film or membrane is Triclosan at concentrations of between about 0.1 - 30% by weight, more suitable from about 0.5 - 15% by weight, and preferably between about 1 - 1.5% by weight, to utilise its anti-inflammatory/anti-microbial therapeutic and wound-healing-promoting properties.

Triclosan (generic name) is a well-known highly effective broad spectrum anti-microbial agent for topical applications, with a wide range of efficacy. It has the following chemical formula:



Triclosan (2,4,4'-trichloro-2'-hydroxy diphenyl ether) has the molecular formula  $C_{12}H_7Cl_3O_2$  and is commercially available under the trade name Irgasan (Ciba-Geigy Limited) e.g. Irgasan DP300. Its physical properties, toxicology and compatibility with various chemicals used in the hygiene area are well documented. Its uses extend from additives to soaps, deodorants and toothpastes to incorporation in textile materials and yarns. It is incorporated into clothing to control the growth of microorganisms between launderings. Other common applications include animal beds, dental floss, shoe innersoles, furniture coverings and public transport seating, to name but a few.

In the medical field it is used in the material of hospital bed sheets, surgical drapes, hospital gowns, operating gowns, and medical masks. Potential medical applications include bandages, gauze, filters and anywhere a textile or textile fibre could be used to control mould, mildew, fungus, yeast or bacterial growth.

In recent veterinary trials with woven bandages, developed by me and made from polymeric fibres incorporating Triclosan, the bandages exhibited a hitherto unexpected therapeutic, possibly synergistic, property, which essentially promotes better wound care

management and wound healing. This in turn has led to the development of the present invention and the use of Triclosan-containing polymers in improved infection control and wound care management following, for example, surgical procedures.

Triclosan is readily available commercially with a purity greater than 99%. The compound exhibits marked anti-microbial properties across a wide range of bacteria, fungi, and viruses. In its usage to date, Triclosan has not induced resistance in exposed organisms. The product has been marketed for many years as an anti-microbial system for preserving cosmetics and industrial products, for oral care products such as toothpaste and/or hand disinfectants. Through these uses it has undergone extensive toxicological testing and been found to be safe at recommended concentrations. Irgasan also has considerable anti-inflammatory activity. Additionally, the chemical has good environmental properties, yet is stable to hydrolysis. It is poorly soluble in water and highly soluble in many organic solvents.

The properties of Triclosan have not previously been considered to be therapeutic in nature. According to the present invention it is proposed that, by appropriate application, the chemical can be used in therapeutic situations in conjunction with bandages and wound dressings.

According to the invention, Triclosan is incorporated into the polymer material by addition of Triclosan during the mixing/polymerisation stage, whereby the Triclosan is colloiddally and homogeneously suspended within the amorphous zone of the polymer. The Triclosan also acts as a plasticiser with some polymers, e.g. polyurethane. Depending on the specific polymer, the Triclosan may obviate the need to use a separate plasticiser in the polymeric material. The Triclosan softens the polymer for processing and provides a degree of elasticity in the formed membrane.

The Triclosan is introduced into the interstitial spaces of the polymer material in such a way as to not effect the physical properties of the polymer/plastics material. These spaces act as reservoir for the Triclosan from which sub-micron sized particles thereof migrate to the surface of the polymer on demand. There they become a tightly bound durable part of



the surface itself. In this way Triclosan in the bandage or wound dressing provides continuous inherent control of the growth of a broad range of microorganisms, including gram-positive and gram-negative bacteria, as well as fungi, moulds, mildew and yeasts. Triclosan is also believed to exhibit some virus-inactivating properties which prevent virus replication.

Triclosan penetrates and disrupts the metabolic function of thin-walled microorganisms, interrupting their ability to function, grow and reproduce. Normal human cells are thick-walled, and are therefore unaffected by Triclosan.

In use, the continuous presence of Triclosan in the bandage or wound dressing prevents or reduces broad spectrum microbial growth and inflammatory processes in the underlying wound area and promotes ideal conditions for wound healing.

Although exemplary embodiments of the present invention have been referred to herein, it will be apparent to those having ordinary skill in the art that a number of changes, modifications or alterations to the invention described herein may be made, none of which depart from the spirit of the present invention. All such changes, modifications and alterations should therefore be seen as being within the scope of the present invention.

It should be appreciated that the present invention provides a substantial advance in anti-microbial bandages and wound care management, providing all the herein-described advantages without incurring any relative disadvantages.

**CLAIMS**

1. A bandage or dressing for wound care management, comprising an outer fabric support, an inner support layer having an outer surface incorporating a therapeutically effective amount of one or more therapeutically active compounds in the matrix thereof.
2. An absorbent pad for wound care management, comprising a gas and/or liquid pervious body-side liner, an outer cover sheet and an absorbent body disposed therebetween, wherein the said line and/or the said absorbent body are fabricated from materials which incorporate a therapeutically effective amount of one or more therapeutically active compounds in the matrix or interstitial spaces thereof.
3. A wound care dressing as claimed in Claim 1 or Claim 2, wherein the said therapeutically active compounds include at least one anti-microbial compound.
4. A wound care dressing as claimed in Claim 3, wherein the therapeutically active compounds comprise Triclosan.
5. A wound care dressing as claimed in Claim 3 or Claim 4, wherein the therapeutically active compounds comprise between about 0.1% to about 30% by weight of the body-side liner and/or of the absorbent body.
6. A wound care dressing as claimed in Claim 3 or Claim 4, wherein the therapeutically active compound comprises between about 0.5% to about 15% by weight of the body side liner and/or the absorbent body.
7. A wound care dressing as claimed in Claim 3 or Claim 4, wherein the therapeutically active compound comprises between about 1 and about 1.5% by weight of the body side liner and/or the absorbent body.
8. A wound care dressing as claimed in any one of the preceding claims, wherein the inner support layer or body-side liner comprises a synthetic polymeric material.

9. A wound care dressing, as claimed in any one of Claims 1 to 7, wherein the inner support layer or body-side liner comprises a natural polymeric material.

10. A wound care dressing as claimed in Claim 8 or Claim 9, wherein the inner support layer or body-side liner comprises a polymeric material selected from silastic or other silicone-based material polyethylene terephthalate (PET), dacron, knitted dacron, velour dacron, polyglacin, chromic gut, nylon, silk, bovine arterial graft, polyethylene (PE), polyurethane, polyvinyl chlorides silastic elastomer, silicone rubber, PMMA [poly-(methyl methacrylate), latex, polypropylene (PP) polyofefin, cellulose, poly vinyl] alcohol (PVA), poly (hydroxyethyl methacrylate (PHEMA), poly (glycolic acid), poly (acrylonitrile) (PAN), fluoroethylene-cohexa-fluoropropylene (FEP), teflon (PTFE), Co-Cr alloys, copolymers thereof and mixtures thereof.

11. A method for the manufacture of a therapeutically effective bandage or wound care dressing, which comprises including a therapeutically effective amount of a therapeutically active compound within the matrix of the wound care dressing material prior to forming the wound care dressing.

12. A method according to Claim 11, wherein the therapeutically active compound is Triclosan.

## INTERNATIONAL SEARCH REPORT

International Application No.  
PCT/AU 97/00144**A. CLASSIFICATION OF SUBJECT MATTER**Int Cl<sup>6</sup>: A61L 15/44, 15/22, 15/24, 15/26, 15/28, 15/30

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC A61L 15/44, 15/03, 15/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DERWENT: TRICLOSAN, ANTIMICROB, ANTIBACT

JAPIO: TRICLOSAN, ANTIMICROB, ANTIBACT

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 93/02717 A (SMITH & NEPHEW PLC) 18 February 1993 page 2 line 25 - page 3 line 20, page 6 line 1 - page 8 line 16	1-12
X, <u>Y</u>	Derwent Abstract Accession No. 92-398476/48, class P32 P34, WO 9219194 A (KOTEC LTD) 12 November 1992 abstract	1-3, 5-11, 4, <u>12</u>
X, <u>Y</u>	EP 72251 A (LECTEC CORP) 16 February 1983 claims 1, 8-10	1-3, 5-11, 4, <u>12</u>



Further documents are listed in the continuation of Box C



See patent family annex

## \* Special categories of cited documents:

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Date of the actual completion of the international search

27 March 1997

Date of mailing of the international search report

04.04.97

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PCT/AU 97/00144

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X, <u>Y</u>	EP 475807 A (TERUMO KK) 18 March 1992 page 2 line 53 - page 3 line 13	1-3, 5-11, 4, <u>12</u>
P, X, <u>Y</u>	Derwent Abstract Accession No. 97-126713/12, class A96 B07 D22 F07 P32 P34, JP 09010296 A (UNITIKA LTD) 14 January 1997 abstract	1-3, 5-11, 4, <u>12</u>
X, <u>Y</u>	Derwent Abstract Accession No. 92-421002/51, class P32 P34, JP 04317654 A (KOTEC KK) 9 November 1992 abstract	1-3, 5-11, 4, <u>12</u>
X, <u>Y</u>	Derwent Abstract Accession No. 91-249360/34, class P32 P34, JP 03162853 A (COTECH KK) 21 November 1989 abstract	1-3, 5-11, 4, <u>12</u>
X, <u>Y</u>	Derwent Abstract Accession No. 66758 D/37, class A96 B07, JP 56092-209 A (NITTO ELECTRIC IND KK) 25 July 1981 abstract	1-3, 5-11, 4, <u>12</u>
Y	US 5098693 A (FAAS, Jr. et al.) 24 March 1992 col. 3 lines 22-26	4, 12

# INTERNATIONAL SEARCH REPORT

International Application No.

Information on patent family members

PCT/AU 97/00144

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
WO	93/02717	AU	23970/92	ZA	9205975		
WO	9219194	EP	584361	US	5584801		
EP	72251	CA	1206095	US	4675009	US	4307717
		JP	57115253	US	4125110	JP	54077489
		GB	2034184				
EP	475807	AU	82530/91	JP	4108454	US	5395305
		JP	4129561				
US	5098693						
END OF ANNEX							